



Integrated Device Technology, Inc.

## 3.3V CMOS OCTAL BIDIRECTIONAL TRANSCIVERS

IDT54/74FCT3245/A

### FEATURES:

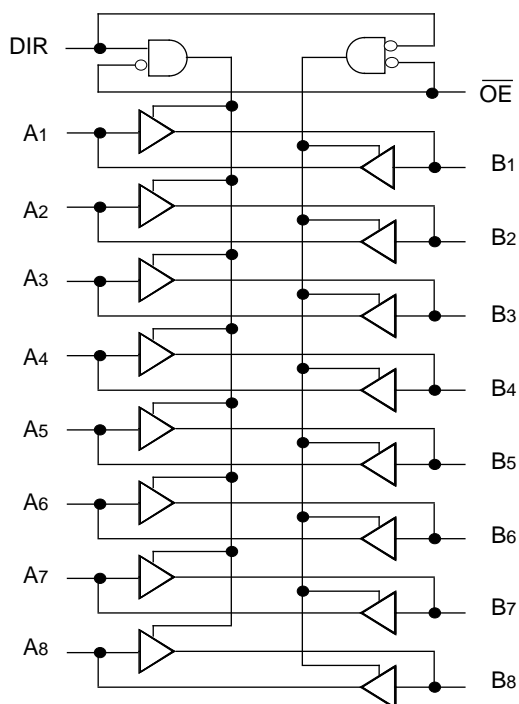
- 0.5 MICRON CMOS Technology
- ESD > 2000V per MIL-STD-883, Method 3015;  
> 200V using machine model (C = 200pF, R = 0)
- 25 mil Center SSOP and QSOP Packages
- Extended commercial range of -40°C to +85°C
- VCC = 3.3V ±0.3V, Normal Range or  
VCC = 2.7V to 3.6V, Extended Range
- CMOS power levels (0.4μW typ. static)
- Rail-to-Rail output swing for increased noise margin
- Military product compliant to MIL-STD-883, Class B

### DESCRIPTION:

The FCT3245/A octal transceivers are built using advanced dual metal CMOS technology. These high-speed, low-power transceivers are ideal for synchronous communication between two busses (A and B). The direction control pin (DIR) controls the direction of data flow. The output enable pin ( $\overline{OE}$ ) overrides the direction control and disables both ports. All inputs are designed with hysteresis for improved noise margin.

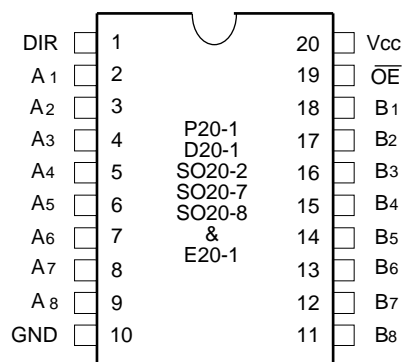
The FCT3245/A have series current limiting resistors. These offer low ground bounce, minimal undershoot, and controlled output fall times-reducing the need for external series terminating resistors.

### FUNCTIONAL BLOCK DIAGRAM

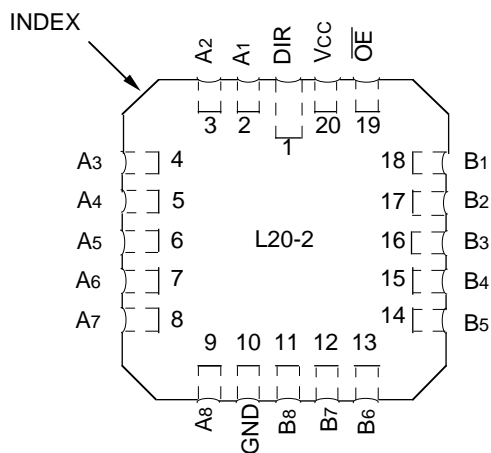


2650 drw 01

### PIN CONFIGURATIONS



DIP/SOIC/SSOP/QSOP/CERPACK  
TOP VIEW



LCC  
TOP VIEW

2650 drw 02

2650 drw 03

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**MILITARY AND COMMERCIAL TEMPERATURE RANGES**

**FEBRUARY 1996**

## PIN DESCRIPTION

Pin Names	Description
$\overline{OE}$	Output Enable Input (Active LOW)
DIR	Direction Control Input
Ax	Side A Inputs or 3-State Outputs
Bx	Side B Inputs or 3-State Outputs

2650 tbl 01

## FUNCTION TABLE<sup>(1)</sup>

Inputs		Outputs
$\overline{OE}$	DIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

2650 tbl 02

### NOTE:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
Z = High Impedance

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Symbol	Rating	Commercial	Military	Unit
VTERM <sup>(2)</sup>	Terminal Voltage with Respect to GND	−0.5 to +4.6	−0.5 to +4.6	V
VTERM <sup>(3)</sup>	Terminal Voltage with Respect to GND	−0.5 to +7.0	−0.5 to +7.0	V
VTERM <sup>(4)</sup>	Terminal Voltage with Respect to GND	−0.5 to V <sub>CC</sub> + 0.5	−0.5 to V <sub>CC</sub> + 0.5	V
T <sub>A</sub>	Operating Temperature	−40 to +85	−55 to +125	°C
T <sub>BIAS</sub>	Temperature Under Bias	−55 to +125	−65 to +135	°C
T <sub>STG</sub>	Storage Temperature	−55 to +125	−65 to +150	°C
P <sub>T</sub>	Power Dissipation	1.0	1.0	W
I <sub>OUT</sub>	DC Output Current	−60 to +60	−60 to +60	mA

2650 lmk 03

### NOTES:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
- V<sub>CC</sub> terminals.
- Input terminals.
- Output and I/O terminals.

## CAPACITANCE (T<sub>A</sub> = +25°C, f = 1.0MHz)

Symbol	Parameter <sup>(1)</sup>	Conditions	Typ.	Max.	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V	3.5	6.0	pF
C <sub>I/O</sub>	I/O Capacitance	V <sub>OUT</sub> = 0V	4.0	8.0	pF

2650 lmk 04

### NOTE:

- This parameter is measured at characterization but not tested.

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 2.7\text{V}$  to  $3.6\text{V}$ ; Military:  $T_A = -55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{CC} = 2.7\text{V}$  to  $3.6\text{V}$

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$V_{IH}$	Input HIGH Level (Input pins)	Guaranteed Logic HIGH Level		2.0	—	5.5	V
	Input HIGH Level (I/O pins)			2.0	—	$V_{CC}+0.5$	
$V_{IL}$	Input LOW Level (Input and I/O pins)	Guaranteed Logic LOW Level		-0.5	—	0.8	V
$I_{IH}$	Input HIGH Current (Input pins) <sup>(6)</sup>	$V_{CC} = \text{Max.}$	$V_I = 5.5\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
	Input HIGH Current (I/O pins) <sup>(6)</sup>		$V_I = V_{CC}$	—	—	$\pm 1$	
$I_{IL}$	Input LOW Current (Input pins) <sup>(6)</sup>		$V_I = \text{GND}$	—	—	$\pm 1$	
	Input LOW Current (I/O pins) <sup>(6)</sup>		$V_I = \text{GND}$	—	—	$\pm 1$	
$I_{OZH}$	High Impedance Output Current (3-State Output pins) <sup>(6)</sup>	$V_{CC} = \text{Max.}$	$V_O = V_{CC}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{OZL}$			$V_O = \text{GND}$	—	—	$\pm 1$	
$V_{IK}$	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
$I_{ODH}$	Output HIGH Current	$V_{CC} = 3.3\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_O = 1.5\text{V}^{(3)}$		-36	-60	-110	mA
$I_{ODL}$	Output LOW Current	$V_{CC} = 3.3\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_O = 1.5\text{V}^{(3)}$		50	90	200	mA
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -0.1\text{mA}$	$V_{CC}-0.2$	—	—	V
			$I_{OH} = -3\text{mA}$	2.4	3.0	—	
		$V_{CC} = 3.0\text{V}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -6\text{mA MIL.}$ $I_{OH} = -8\text{mA COM'L.}$	2.4 <sup>(5)</sup>	3.0	—	
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 0.1\text{mA}$	—	—	0.2	V
			$I_{OL} = 16\text{mA}$	—	0.2	0.4	
			$I_{OL} = 24\text{mA}$	—	0.3	0.55	
		$V_{CC} = 3.0\text{V}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 24\text{mA}$	—	0.3	0.50	
$I_{OS}$	Short Circuit Current <sup>(4)</sup>	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$		-60	-135	-240	mA
$V_H$	Input Hysteresis	—		—	150	—	mV
$I_{CCL}$ $I_{CCH}$ $I_{CCZ}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.},$ $V_{IN} = \text{GND or } V_{CC}$	COM'L.	—	0.1	10	$\mu\text{A}$
			MIL.	—	0.1	100	

### NOTES:

2650 Ink 05

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.
- Not more than one output should be tested at one time. Duration of the test should not exceed one second.
- This parameter is guaranteed but not tested.
- $V_{OH} = V_{CC} - 0.6\text{V}$  at rated current.
- The test limits for this parameter is  $\pm 5\mu\text{A}$  at  $T_A = -55^{\circ}\text{C}$ .

## POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$\Delta I_{CC}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.}$	$V_{IN} = V_{CC} - 0.6V^{(3)}$	—	2.0	30	$\mu A$
$I_{CCD}$	Dynamic Power Supply Current <sup>(4)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $\overline{OE} = \text{DIR} = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	60	85	$\mu A/\text{MHz}$
$I_C$	Total Power Supply Current <sup>(6)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $f_i = 10\text{MHz}$ 50% Duty Cycle $\overline{OE} = \text{DIR} = \text{GND}$ One Bit Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.6	0.9	mA
			$V_{IN} = V_{CC} - 0.6V$ $V_{IN} = \text{GND}$	—	0.6	0.9	
		$V_{CC} = \text{Max.}$ Outputs Open $f_i = 2.5\text{MHz}$ 50% Duty Cycle $\overline{OE} = \text{DIR} = \text{GND}$ Eight Bits Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	1.2	1.7 <sup>(5)</sup>	
			$V_{IN} = V_{CC} - 0.6V$ $V_{IN} = \text{GND}$	—	1.2	1.8 <sup>(5)</sup>	

### NOTES:

2650 tbl 06

- For conditions shown as max. or min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 3.3V$ ,  $+25^\circ\text{C}$  ambient.
- Per TTL driven input; all other inputs at  $V_{CC}$  or  $\text{GND}$ .
- This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
- Values for these conditions are examples of the  $I_{CC}$  formula. These limits are guaranteed but not tested.
- $I_C = I_{\text{QUIESCENT}} + I_{\text{INPUTS}} + I_{\text{DYNAMIC}}$   
 $I_C = I_{CC} + \Delta I_{CC} \text{ DHNT} + I_{CCD} (f_{CP} \text{NCP}/2 + f_i \text{Ni})$   
 $I_{CC} = \text{Quiescent Current (} I_{CCL}, I_{CCH} \text{ and } I_{CCZ} \text{)}$   
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input}$   
 $\text{DH} = \text{Duty Cycle for TTL Inputs High}$   
 $\text{NT} = \text{Number of TTL Inputs at DH}$   
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$   
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$   
 $\text{NCP} = \text{Number of Clock Inputs at } f_{CP}$   
 $f_i = \text{Input Frequency}$   
 $\text{Ni} = \text{Number of Inputs at } f_i$

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE<sup>(3)</sup>

Symbol	Parameter	Condition <sup>(1)</sup>	FCT3245				FCT3245A				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
tPLH	Propagation Delay	CL = 50pF RL = 500Ω	1.5	7.0	1.5	7.5	1.5	4.6	1.5	4.9	ns
tPHL	A to B, B to A										
tPZH	Output Enable Time		1.5	9.5	1.5	10.0	1.5	6.2	1.5	6.5	ns
tPZL	$\overline{\text{OE}}$ to A or B										
tPHZ	Output Disable Time		1.5	7.5	1.5	10.0	1.5	5.0	1.5	6.0	ns
tPLZ	$\overline{\text{OE}}$ to A or B										
tPZH	Output Enable Time	DIR to A or B <sup>(4)</sup>	1.5	9.5	1.5	10.0	1.5	6.2	1.5	6.5	ns
tPZL	DIR to A or B <sup>(4)</sup>										
tPHZ	Output Disable Time	DIR to A or B <sup>(4)</sup>	1.5	7.5	1.5	10.0	1.5	5.0	1.5	6.0	ns
tPLZ	DIR to A or B <sup>(4)</sup>										

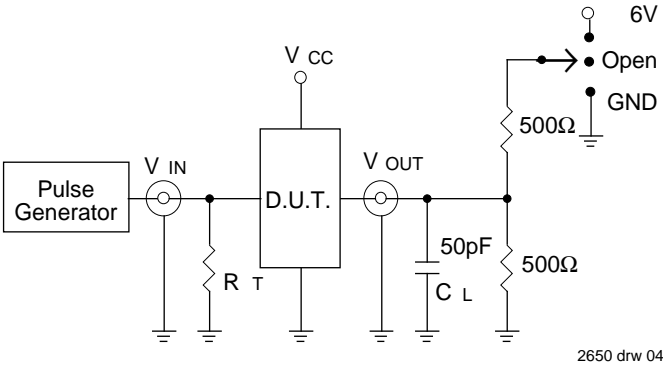
### NOTES:

2650 tbl 07

- See test circuit and waveforms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- Propagation Delays and Enable/Disable times are with  $V_{CC} = 3.3V \pm 0.3V$ , Normal Range. For  $V_{CC} = 2.7V$  to  $3.6V$ , Extended Range, all Propagation Delays and Enable/Disable times should be degraded by 20%.
- This parameter is guaranteed but not tested.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS

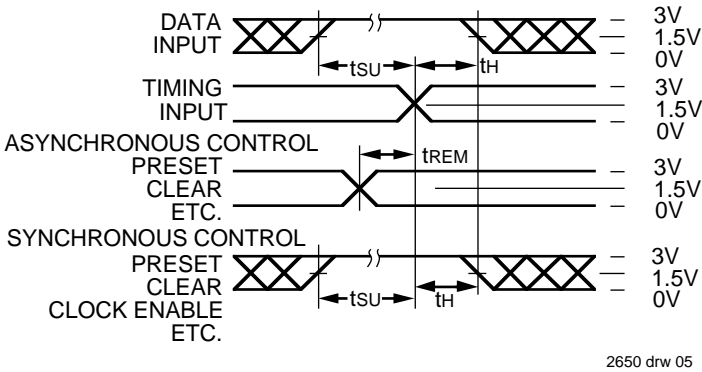


SWITCH POSITION

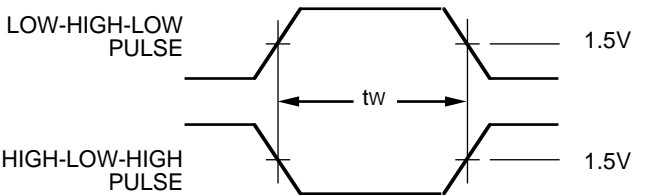
Test	Switch
Open Drain Disable Low Enable Low	6V
Disable High Enable High	GND
All Other tests	Open

**DEFINITIONS:** 2650 Ink 08  
C<sub>L</sub>= Load capacitance: includes jig and probe capacitance.  
R<sub>T</sub>= Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

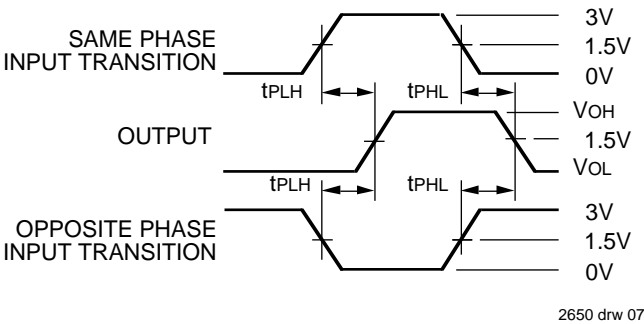
SET-UP, HOLD AND RELEASE TIMES



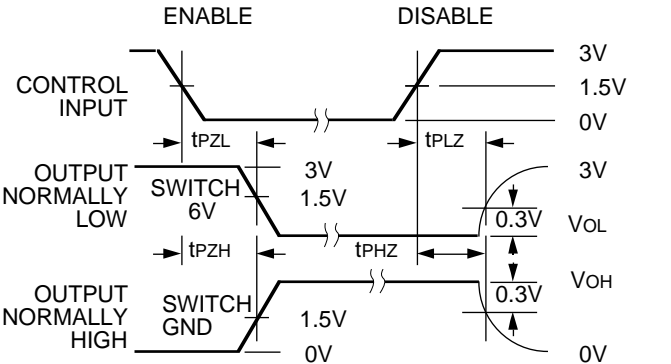
PULSE WIDTH



PROPAGATION DELAY



ENABLE AND DISABLE TIMES



**NOTES:**  
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.  
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t<sub>f</sub> ≤ 2.5ns; t<sub>r</sub> ≤ 2.5ns.  
3. If V<sub>CC</sub> is below 3V, input voltage swings should be adjusted not to exceed V<sub>CC</sub>.

ORDERING INFORMATION

IDT	XX	FCT	X	XX	X	X		
Temp. Range		Family	Device Type	Package	Process			
						Blank	Commercial	
						B	MIL-STD-883, Class B	
						P	Plastic DIP (P20-1)	
						D	CERDIP (D20-1)	
						SO	Small Outline IC (SO20-2)	
						PY	Shrink Small Outline Package (SO20-7)	
						Q	Quarter-size Small Outline Package (SO20-8)	
						245	Non-Inverting Octal Bidirectional Transceiver	
						245A		
						3	3.3Volt	
						54	−55°C to +125°C	
						74	−40°C to +85°C	

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